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Restrictive or expansive selection: the uneven role of tariff structure in improving market access

Carmen Fillat-Castejón*

Department of Applied Economics and Economic History, University of Zaragoza, Zaragoza, Spain

We estimate the effect of tariff reforms on market access from the Doha Round until the Great Recession. Gravity estimates yield significant effects of the variation in tariff structure. The change in the Mercantilist Trade Restrictiveness Index reveals that the change in tariff dispersion reflects a restrictive selection counteracting the effect of average tariff reductions. Restrictiveness is concentrated in East Asia and Pacific while, in Latin America and Caribbean, selection is expansive. We illustrate reforms in China, finding strong restrictive selection. Simulations highlight reforms with unchanged dispersion for their larger improvement in market access and a simultaneous improvement in welfare.

Keywords: trade restrictiveness; tariff structure; tariff reform; gravity equation; market access; Asia and Pacific trade

JEL Classifications: F13, F14, F15

1. Introduction

The steady, global reduction in average tariffs has been fraught with important difficulties in their international negotiations, along with a proliferation of other policy instruments and non-tariff measures that interfere with trade flows. In some developing countries, tariff barriers are still high and other recent practices, such as maintaining tariff peaks and possible protectionist reactions to the financial crisis, have originated a large tariff disparity across products (Milner 2013). The motivations for developing countries to maintain a tariff structure with very high tariffs on some products are very diverse: Pressures for protection varying across industries, strong political resistance to concessions in international negotiations, and incentives for exceptions in tariff liberalization. Another important reason to maintain certain tariffs at high levels is the dependence on tariff income.

The aim of this paper is to analyze the role of tariff dispersion across products and tariff reforms in improving market access, considering the important revenue dependence of many countries. We estimate the improvement in market access that results from the tariff reforms that took place between the Doha Round and the collapse of world trade in 2009 in the Great Recession. We use a gravity-based model to analyze whether the changes in a country's tariff structure had a significant effect on accessibility. For a sample of 97 countries with the data available from 2001 to 2009, we estimate a consistent and theoretically-based indicator of the change in market access, the growth of Anderson and Neary's Mercantilist Restrictiveness Index (MTRI).

The main contribution of this paper is to provide, as far as we know, the first estimation of the growth of the MTRI for the largest available sample and during a long period. Moreover, we assess whether the observed reductions in tariffs have entailed a trade expansive reform and a growth of imports or, on the contrary, if they are concentrated in products with a small or null effect on imports, implying a restrictive or neutral selection, respectively. We find important regional differences with diverse reform strategies where the role of tariff structure in improving market access contrasts with the conventional picture of trade openness. Latin American countries increased their dispersion producing an expansive selection of tariffed goods and total imports. In East Asia and Pacific, the dispersion had a dominant restrictive effect on imports that reduces market access. In the global economy, we still find scope for tariff policies that guide negotiations with a view to the effects of tariff dispersion.

A second contribution of the paper is to provide a useful methodology to estimate the effect of tariff reforms in individual countries when there are long-time series or when we can exploit the abundant information of a panel data. Finally, as a third contribution, our methodology can be used to simulate alternative tariff reforms and evaluate their effect on market access. As an illustration, we evaluate tariff reforms in China from 2000 to 2009, a case of great interest, given the scope for trade liberalization in East Asia and Pacific, and the magnitude of the potential effects of China's trade policy.

The paper is organized as follows: Section 2 explains the empirical model used to estimate the growth of market access. Section 3 shows the estimation results, underlining the heterogeneous role of tariff structure depending on the geographical region. Section 4 summarizes the robustness analysis. Section 5 estimates the effects of tariff reforms on market access by country and year and presents the average effects by region. Section 6 applies our model to estimating the effects of tariff reforms and to simulating diverse tariff cuts in the case of China. We illustrate the convenience of tariff reforms focusing more on dispersion in order to impose market access and welfare.

2. Changes in tariff structure and market access

Tariff structures change in response to varied mixtures of incentives. Protection rates vary in response to a range of pressures resulting in tariff dispersion and peaks in developing countries (Milner 2013). Multilateral international negotiations have been searching to apply tariff reductions that are based on formulas, such as the proportional or the Swiss formulas, to ensure a balanced exchange of concessions and to reduce relatively high barriers by more than lower barriers. In these top-down negotiations, the most heavily protected products create stronger political resistance, because they are required to accept larger concessions, generating exceptions and special cases. So, more recent practical proposals suggest more flexible formulas with similar cuts in the average tariff and smaller reductions in peak tariffs. Although some economic efficiency would be sacrificed, this flexibility would be preferable as a way of reaching politically-acceptable agreements (Francois and Martin 2003).

Dependence on tariff income is another important reason to maintain certain tariffs at high levels. Baunsgaard and Keen (2010) review the empirical evidence on the revenue motives of trade policy during recent decades and conclude that trade liberalization in many developing countries may be hindered unless they find alternative sources of revenues such as domestic taxes. Many low-income countries do not recoup lost tariff revenues from domestic taxation and continue to rely heavily on trade taxes as a source of government revenue, particularly in Sub-Saharian Africa and Asia. Many of these

countries' rents come from resource extraction or aid tariff revenues. Collier and Venables (2011) demonstrate that tariff revenues are illusory in resource-rich and aid-rich countries because they are offset by reductions in real revenues, a fact that should be recognized by trade policy formulations. Gawande, Hoekman, and Cui (2015) analyze the role of vertical specialization in recent trade policy responses for a group of emerging market countries that are historically very active in trade policy. They find that Global Value Chains have been the most important economic factor in the anti-protectionist reactions to the 2008 crisis and that the demand for cheaper intermediates dominates the need of tariff revenue in countries such as India, Argentina, Chile, and South Africa.

In an international context of tariffs in developed countries that are already low, the WTO Doha Round, from 2001 onwards, is regarded as the last chance to extract tariff concessions from developing countries. With the successful stories of rapid growth in emerging countries, improvement in market access is a fundamental requirement for the global liberalization of trade and the origin of disagreements on the balance of concessions (Bayoumi 2011). Progress in market access is an issue of particular relevance not only for developed, but especially for developing countries because, when they try to access international markets, other developing countries are among their main economic partners (Francois et al. 2005; Michalopoulos and Ng 2013). Laborde, Martin, and van der Mensbrugghe (2013) evaluate the welfare impacts of the Doha 2008 proposals on market access for the developing countries using an optimal method of aggregation to obtain the weighted average tariff (w.a.t.) and simulating the impact of different formulas of tariff reduction in the w.a.t.

The proposals imply important concessions and reductions in peaks that allow them to achieve about one third of the total liberalization, with a number of developing countries, such as Pakistan and Sri Lanka experiencing much larger gains because of their much larger initial tariffs. Developing countries, such as Pakistan, Brazil, or India, are negotiating their own proposals on market access with the WTO (WTO 2005a, 2005b). They are also very active in regionalism, for example, with the signing of the South Asian Free Trade Agreement (SAFTA). One of the slowest countries in contracting RTAs has been India, and this might have had a negative impact, possible due to its defensive response. Pant and Sadhukhan (2009) analyze if the formation of ASEAN, NAFTA, EU and MERCOSUR had a negative impact on India's exports concluding that RTAs have not been a stumbling block to multilateralism, at least in the case of India.

Large dispersion is common in tariff structures and the effect is not innocuous. Anderson (1993) obtains the very disturbing result that ordinary aggregate measures of trade restrictiveness are frequently of the wrong sign. Anderson and Neary (1994) demonstrate that the well-known underestimation of the w.a.t. as a measure of trade restrictiveness is positively correlated with the dispersion of the tariff structure and formulate the Trade Restrictiveness Index (TRI) as the uniform tariff that would be equivalent, in terms of welfare, to any pattern of tariff structure. Bach and Martin (2001) derive indicators based on the TRI for groups of products, which are useful for sectoral policies, and simulate sharp reductions in both the mean and the variance of tariffs. They obtain additional welfare gains over the w.a.t. which are due to the substitution effect and consist of lower expenditure and more tariff revenue. A formalization of the same argument is provided in Francois and Martin (2004), adopting a general equilibrium approximation of the cost of protection on imports.

To evaluate reciprocity in trade negotiations and market access more adequately, Anderson and Neary (2003) develop the Mercantilist Trade Restrictiveness Index (MTRI) as the uniform tariff that would be equivalent, in terms of the value of imports at the world

prices, to any pattern of tariff structure. Anderson and Neary (2005, 2007) formalize the effects of tariff reforms on the change in both the TRI and the MTRI, which are completely defined by the first and second generalized moments of the country's tariff structure. While the MTRI does not depend on tariff dispersion, the change in tariff variance has a well-defined and opposite effect on the changes in TRI and MTRI. The only tariff reduction formula that raises both welfare and market access is a uniform absolute cut in tariff rates, which maintains the domestic relative prices among tariffed goods, that is, it leaves tariff dispersion unchanged. Unfortunately, this formula reduces tariff revenue, which is an important source of income and a principle reason for maintaining large tariff dispersion in many developing countries. However, when tariff revenue matters, Anderson and Neary (2016) find a theoretical foundation for the standard World Bank advice of reducing tariff while maintaining average tariffs to preserve revenues. In this case, Bach and Martin (2001) and Anderson and Neary (2005, 2007, 2016) demonstrate that expenditure on imports is reduced and improvement in market access is sacrificed.

Countries' observed tariff structures are mixed combinations of tariff average and dispersion with diverse effects on trade restrictiveness. Anderson (2009) simulates total trade liberalization in India and demonstrates that, when tariff dispersion is important, the substitution and income effects can yield substantial differences between consistent and standard indicators of aggregate trade restrictiveness. Diakantoni and Escaith (2009) find no clear relationship between a country's level of development and its tariff structure and high dispersion in some developed countries. Michalopoulos and Ng (2013) examine trade policies from the 90s to 2012 and find a regional pattern in tariffs. Latin America has limited all tariffs, particularly in manufacturing, and dispersion remained intact in countries such as Uruguay. Other countries, such as Argentina and Brazil show a decreasing tariff dispersion with a change toward an increase from 2006-2007. Cuenca, Navarro, and Gómez (2013) confirm the creation effect of MERCOSUR, with differences by country. Isakova, Koczan, and Plekhanov (2016) study changes in tariff structure with the customs union of Russia, Belarus, and Kazakhstan, finding both trade creation and deviation. In Africa and Asia, many countries have limited a small fraction of tariffs in goods outside agriculture. Jones, Morrissey, and Nelson (2011) find a compression of the tariff dispersion in Eastern Africa between the early 1990s and the early 2000s. Mathur and Sachdeva (2005) describe the tariff structure in India from 1991 to 2005, where average tariffs have decreased and dispersion across all commodities decrease, with important peaks in agriculture. Other countries in the region, such as Pakistan, show important reductions in tariff dispersion. Pursell (2011) reviews trade policies in South Asia, finding a general cut of tariffs and a simplification of tariff structures between 1990 and 1997, but an increase in the protectiveness of the tariff system from early 2001. Sri Lanka is a little more open, particularly in the industrial sector.

In the case of China, Cheng and Feng (2000) show that trade policy has tended to extend protection to those industries with relatively high average wages and high value added per worker. For the sake of social and political stability, there is a gradual phase-out of the protection of the declining industries. Kalirajan and Singh (2008) compare China's and India's export and growth performances. China has been progressively reducing average tariffs from their very high levels and has gradually shifted toward the East Asian model of export-oriented growth. As a commitment upon its WTO accession in 2001, China eliminated practically all its non-tariff barriers NTBs in the early 2000s. However, there is room for further improvement in China's trade policies. India is an outlier compared to world standards, with peak tariffs in almost all products, so trade reforms still focus on tariff reductions more than in their dispersion.

Francois, Rana, and Wignaraja (2009) study the effects of a Pan-Asian integration. They consider the integration of ASEAN countries plus China, Japan and Korea (ASEAN+3), with important effects on trade with India and on intraregional trade in South Asia. They conclude that, although the levels of tariffs and NTBs are low in East Asia, there is further room for reductions. Rana and Dowling (2009) describe the lessons that South Asia can learn from the East Asian experience in trade integration but historical hostility hinders agreements to move toward a uniform and low tariff rate.

3. Estimating progress in market access in a gravity framework

Our estimation of the progress in market access is based on a gravity model aggregated from the individual trade flows at product level k. In this way, we can use the existing information on tariff data and NTBs, which are available for each importer (j) detailed by exporter (i) and product (k). According to Anderson and van Wincoop (2004), the individual structural gravity equation for importer (j) at the exporter-product level (ik) is expressed by Equation (1):

$$Z_{ijk} = \frac{y_i^k yj}{y^w}\left(\frac{(1+\tau_{ijk})}{\Pi_i^k P_j^k}\right)^{1-\sigma} \tag{1}$$

Z_{ijk} are the total imports for country j from exporter-product ik; y_i^k is the production in country i devoted to good k, that is, the income generated by country i with product k; y_j is the income of importer country j; τ_{ijk} is the bilateral trade cost for product k from exporter i, expressed as the *ad valorem* rates on world prices; σ is the elasticity of substitution; and Π_i^k and P_j^k are the Multilateral Resistance terms (MR) for product k.

Taking logs and differentiating Equation (1), then aggregating all the import flows from the exporter-product level ik, we obtain an approximation to the growth rates of the aggregate imports of country j. Equation (2) expresses the aggregate gravity equation in growth rates, where m_{ijk} is the share of imports of product k from origin country i (ik) and the year index t is omitted for simplicity.

$$\begin{aligned} gZ_j &= \sum_i \sum_k m_{ijk} gZ_{ijk} \cong \sum_i \sum_k m_{ijk} \Delta \log Z_{ijk} \\ &= \Delta \log y_j - \Delta \log y^w + \sum_i \sum_k m_{ijk} \Delta log y_i^k - \\ &\quad - (1-\sigma) \sum_i \sum_k m_{ijk} \left[\Delta \log \pi_i^k + \Delta \log P_j^k\right] \\ &\quad + (1-\sigma) \sum_i \sum_k m_{ijk} \Delta \log(1+\tau_{ijk}) \end{aligned} \tag{2}$$

The last term in Equation (2) is an aggregator of the changes in individual trade costs on country's j import bundle τ_{ijk}, which we can represent as $g(1+\tau j)$.

$$\sum_i \sum_k m_{ijk} g(1+\tau_{ijk}) = \sum_i \sum_k m_{ijk} \Delta \log\left(1+\tau_{ijk}\right) = g\left(1+\tau_j\right) \tag{3}$$

As trade costs, we have considered tariffs and NTBs. The available information on NTBs allows us to include a proxy of the aggregate incidence of the variations in the

NTBs affecting each product and country of origin. In the case of tariffs, a consistent aggregation that considers the general equilibrium effects and cross-price effects for the products imported has been formulated by Anderson and Neary (2005, 2007) with their MTRI. If we consider only tariffs in Equation (3), the growth of the trade costs aggregator is the growth of Anderson and Neary's MTRI.[1] An important property of our gravity model is that it provides an estimation of the growth of the MTRI, which Anderson and Neary demonstrate is fully defined by the changes in the observable import-weighted average tariff ($\mathrm{d}\bar{T}$) and the import-weighted tariff variance ($\mathrm{d}V$), as follows:

$$\mathrm{gMTRI}_j = g\left(1+\tau_j^{MTRI}\right) = \varphi^{\mu}\left[\mathrm{d}\bar{T}_j - \frac{\frac{1}{2}\left(1-M_{bj}\right)\mathrm{d}V_j}{1-\left(1-M_{bj}\right)\bar{T}_j}\right] \tag{4}$$

where M_{bj} is the marginal propensity to spend on imports and ϕ is a positive parameter that can be assumed close to unity.

Finally, the change and aggregation of the MR terms Π_i and P_j can be controlled with country fixed effects, which also allow us to control for other omitted variables, although this might miss some indirect effects from MR. Alternatively, we have used the methodology of Baier and Bergstrand (2009). Differentiating and aggregating the Baier and Bergstrand solution for the MR terms, we can calculate the growth of MR (GMR) using income shares and tariff associated with each country and product. In Equation (2), we substitute the Anderson and Neary solution for gMTRI, the incidence of the NTBs (GNTBs) and the Baier and Bergstrand term (GMR), assuming the theoretical value of $\varphi^{\mu} = 1$ and using $b = 1/2(1 - M_b)$, so our gravity model in growth rates becomes:

$$\begin{aligned} gZj \quad &= \Delta\log y_j - \Delta\log y^w + \sum_i\sum_k m_{ik}\Delta\log y_i^k - (1-\sigma)\mathrm{GMR} \\ &+(1-\sigma)\left[\mathrm{d}\bar{T} - \frac{\frac{1}{2}\left(1-M_{bj}\right)\mathrm{d}V_j}{1-\left(1-M_{bj}\right)\bar{T}_j}\right] + (1-\sigma)\gamma_j\mathrm{GNTBs}_j \end{aligned} \tag{5}$$

The estimation of parameter $b_j = 1/2(1 - M_{bj})$ provides a test of the role of the variation of the tariff structure resulting from the tariff reforms between the Doha Round and the collapse of trade in 2009, given the variation in the import-weighted average tariff $\mathrm{d}\bar{T}$. As far as we know, this is the first estimation of this parameter in the literature.

The UNCTAD TRAINS database provides the applied tariffs and import shares for all the imported products and from all the country sources. The import-weighted tariff average ($\bar{T}_j$) and variance (V_j) for each importer and year have been computed from the most detailed level of aggregation available, six digits for tariff lines in the Harmonized System (HS). Considering that tariffs for the same product can differ across countries of origin, the calculations imply about a hundred thousand tariff data each year for each of the 97 importer countries with available data from 2001 to 2009, of which 17 are developed countries and 80 are developing countries. Baier and Bergstrand's term (GMR) is computed for each year from PPP-GDP shares and from the tariffs applied by each partner at the tariff line. Importer, exporter and world incomes are taken from the World Development Indicators database, with incomes in PPP exchange rates. Import data are taken from the COMTRADE database. The incidence of changes in NTBs is calculated with data from UNCTAD TRAINS, with an exhaustive revision of

every change in all possible categories of Core-NTBs, taking into account both the implementation of a new NTB and the cancellation of an existing one. A country-year dummy is included in the estimation when a change is detected for an importer and a specific year. We build a sample consisting of an imbalanced data panel with 327 observations. Tariff structure has become less dispersed in all countries, except in the Developed non-OECD countries, in OECD and in Latin America and Caribbean, where import-weighted variance has increased.

We extend Equation (5) to obtain the empirical equation to be estimated:

$$\begin{aligned} gZj = {} & \mathrm{GGDP}_j + \mathrm{GGDPPART}_j - \mathrm{GGDPW} - (1-\sigma)\mathrm{GMR} \\ & + (1-\sigma)\left[d\bar{T} - \frac{b_j \mathrm{d}V_j}{1-2b_j\bar{T}}\right] + (1-\sigma)\gamma_j \mathrm{GNTBs}_j \\ & + \beta_1 \mathrm{GTREV}_j + \beta_2 \mathrm{GOPEN}_j + \beta_3 RTA_j + \varepsilon_j \end{aligned} \tag{6}$$

where GGDP_j is the growth of importer j's GDP. $\mathrm{GGDPPART}_j$ is the growth of the exporter partners' GDP weighted by their import shares in country j. GGDPW is the growth of world GDP. GMR is the growth of the Baier and Bergstrand MR term. GTREV is the growth of tariff revenue. GOPEN is the growth of the importer's openness, an international trend which conditions the volume of trade, measured as the ratio of imports over the importers' GDP. RTA is a dummy that takes the value of 1 when the importer is in a regional trade agreement. Data about tariff revenue, population, per capita GDP and GDP are from the World Development Indicators database and the RTAs considered are the most relevant ones existing or starting during the period analyzed (Rodriguez 2014). Time year dummies are also included to control for any year shock common to the sample and any additional bias that is a consequence of time series correlation (Baldwin and Taglioni 2006). We assume $\sigma = 5$, a value that is commonly used, as in Anderson and van Wincoop (2004), and which is in the range of values reviewed in Hummels (1999) and in Head and Mayer (2013).

4. Estimation results

Table 1 shows the estimated results of the non-linear least squares estimation of Equation (6). Column 1 shows the estimation of the basic model. Column 2 considers changes in NTBs and fixed effects to control for other omitted variables. In columns 3 to 6, the model is extended with other controls. The growth in the tariff revenue (GTREV), is significant as an additional income. The international trend of the importer country (GOPEN), in column 3, is also significant. To avoid the endogeneity problem with this variable, we have used two main determinants of openness, per capita GDP and population, both in growth rates (GPCGDP and GPOP, respectively), following Balassa (1986a, 1986b), Dowrick and DeLong (2003) and Dowrick and Golley (2004). GPCGDP also controls for the factor endowments, as determinants of traded products and partners in the neoclassical theory of trade, and the quality and variety of imports in the New Trade Theory. Only the growth of per capita GDP (GPCGDP) is significant. In column 4, other institutional or geographical shocks have been controlled for by regional-year dummies (WB-year), where the World Bank regional group is interacted with year dummies. The estimated value for parameter b, which captures the effect of the observable change in the tariff structure, is between 0.002 and 0.003 in all cases.

Column 5 includes the effect of all RTAs that are significant individually. The main new RTAs in our studied period are the Free Trade Agreements between US and Korea

Table 1. Estimated results. Baseline model and aditional controls.

Growth of imports	(1)	(2)	(3)	(4)	(5)	(6)	
b	0.0023***	0.0022***	0.0022***	0.0026***	0.0025***	0.0024***	
	(0.022)	(0.029)	(0.003)	(0.014)	(0.012)	(0.020)	
Growth of Tariff Revenue (GTREV)			0.1039***	0.1425***	0.1499***	0.1438***	0.1529***
			(0.006)	(0.002)	(0.001)	(0.002)	(0.011)
Growth of Openness (GOPEN)			0.7203***				
			(0.000)				
Growth of Per Capita GDP (GPCGDP)				0.2691***	0.2734***	0.2754***	0.2848***
				(0.000)	(0.000)	(0.000)	(0.000)
KOR-US					–14.7195***	–15.6002***	–12.8190***
					(0.000)	(0.000)	(0.000)
China-ASEAN					–3.8595		
					(0.470)		
APEC					–2.1765		
					(0.174)		
ASEAN					–6.4993***	–9.0400	
					(0.061)	(0.007)	
Growth of Balassa's Trade Orientation (GTO)						–0.0112***	–0.0121***
						(0.042)	(0.037)
b-Latin America & Caribbean							0.0024***
							(0.002)
b-South Asia							0.0016
							(0.290)
b- East Asia and Pacific							0.0378***
							(0.048)
b-Sub-Saharian Africa							–0.0216
							(0.176)
b-Arab Countries							0.0273
							(0.147)
							–0.0944
							(0.130)
b-OECD							–0.0015
							(0.536)

b-Developed non-OECD						0.0064 (0.115)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Baier-Bergstrand (GMR)	Yes	Yes	Yes	Yes	Yes	Yes
Importer fixed effects		Yes	Yes	Yes	Yes	Yes
Changes in NTBs		Yes	Yes	Yes	Yes	Yes
WB-year				Yes	Yes	Yes
Adj R^2(%)	10.43	20.23	71.32	46.24	47.76	49.79
Obs	327	327	327	327	327	327

Notes: $b = 1/2(1 - M_b)$ where M_b is the marginal propensity to spend on imports. It is assumed the theoretical value of $\phi = 1$.
***,** and * indicate significance at 99, 95, and 90% confidence levels respectively. Robust p-values are in brackets

(KOR-US) signed in 2007 and between US and Singapore in 2003; the Latin American Pacific Basin Initiative incepted in 2006 and consolidated in 2008; the Agreement on Trade in Goods of the China-ASEAN FTA which entered into force in 2005; the FTA between Japan and ASEAN which entered into force in 2008. We also control for participation in the regional blocks MERCOSUR, NAFTA, EU, APEC, and the Latin American group inside APEC, ASEAN and ASEAN+3. NAFTA is almost significant individually and ASEAN+3 yields similar results that. All together in the same equation only KOR-US and ASEAN remain significant, and the value of parameter *b* continues to be 0.0025. In column 6, we control for trade orientation using the growth of Balassa's Trade Orientation measure (GTO).We interpret the negative sign as a larger impact on imports from increasing trade orientation in the early stages of integration which decreases when the country is highly open. The estimated value of coefficient *b* is 0.0024.

It is reasonable to assume that the effect of changes in tariff structure is very heterogeneous and recent literature finds regional differences in tariffs (Michalopoulos and Ng 2013). We have estimated the extended model for each World Bank region, confirming notable differences in the effect of tariff dispersion on market access. Column 7 shows a significant effect of changing tariff structure on Latin America and Caribbean and on East Asia and Pacific. The parameter *b* in Latin America has a value of 0.0024, the same as for the total sample. The particular use of tariff reforms in Latin American countries, with very small reductions in average tariffs but with increasing dispersion, and the number of observations in our sample explain why this region dominates the total result. Although there are heterogeneous uses of tariffs among these countries, this result is attributable to the increase in dispersion after 2006 in Argentina and, especially, in Brazil. This result is consistent with the description of the tariff structure in Latin America in Gawande, Hoekman, and Cui (2015) and might be explained by the selection of intermediates imports linked to Global Value Chains. Parameter *b* in East Asia and Pacific is 0.0378, indicating an important effect of tariff dispersion on imports, 16 times the average effect. China dominates not only international trade, but also this subsample in our analysis, which explains the importance of considering the evolution of tariff structure in this region. However, there is a general reduction in tariff dispersion in almost all countries.

The change in dispersion is not significant in other regions, so they show a neutral tariff selection while their market access increases. This is the case of Sub-Saharian Africa, with a compression on dispersion as Jones, Morrissey, and Nelson (2011) find for Eastern Africa, but with no impact on market access. Europe and Central Asia show no significant effect of tariff structure, in line with Isakova, Koczan, and Plekhanov (2016). This also occurs in Arab countries, OECD, and South Asia; this one deserves further study because of the heterogeneous change in dispersion. In India, according to Anderson (2009) and Mathur and Sachdeva (2005) dispersion increases, but our sample has very few observations and dispersion decreases. Dispersion decreases in Pakistan, which might lead to a restrictive selection in market access coherent with the protective trend found in Pursell (2011). Developed non-OECD countries show no significant effect from the change in tariff dispersion. The heterogeneity and small size of this subsample may explain this result.

5. Robustness analysis

Although the estimated value of b is quite robust, we are aware of other determinants that are important for the growth of imports, as well as the fact that our model is in growth rates and dynamic issues should be considered and that regional and country estimations might yield significant differences. Table 2 summarizes the main robustness analysis.

Column 1 deals with endogeneity in the growth of openness and considers the lagged growth of per capita GDP (lagGPCGDP) and the lagged growth of population (lagGPOP). The results remain the same.

In Column 2, we exclude 2009 and confirm that the collapse in world trade does not change the value of b. Columns 3 and 4 consider the growth of Real Effective Exchange Rate (GREER). An increase of this rate increases imports and our parameter b changes to 0.0039, but the sample is reduced. In column 4, we confirm that this change is due to the reduction in the sample and not to the inclusion of GREER.

Columns 5 and 6 estimate differentiated individual coefficients for Latin America and Caribbean and for East Asia and Pacific, respectively. For brevity, we do not include the individual coefficients for the other regions because they are not significant. The estimated value of b for the general sample is still 0.0025 and the individual b is practically the same as when we consider all regions in the same estimation (Table 1, column 7), similar to the average value for Latin America and Caribbean, and sixteen times larger for East Asia and Pacific. Finally, in column 7, we estimate the value of the elasticity of substitution (σ) as a differentiated parameter in Equation (6), instead of borrowing it from the literature. The estimated sigma is 4.43, very close to the borrowed one, and the results remain the same

We capture half of the variation in the growth of imports and with very robust values for the effect of changes in tariff structure. We leave other possible influences on imports, such as foreign investment and participation in global value chains, in the error term and on our research agenda.

6. Estimation of the effects of tariff reforms on market access (2001–2009)

Our results can be used to calculate the effect of tariff reforms on the growth of imports for every country and year, as well as the change in the uniform tariff that these reforms represent for market access and the quantitative effect of the change in tariff structure. We use in our calculations the values estimated in Table 1, column 7. Although there is a general reduction in the w.a.t., a variation of tariff structure with significant effects on imports can reinforce, weaken, or have no effect on the growth in market access.

Table 3 summarizes the cumulative effect of tariff reforms on market access from 2000 to 2009. Column 1 shows that, for the total sample, tariff reductions contributed to an 18.84% cumulative growth of imports, so tariff reforms can still have an important effect on improving market access. The cumulated growth of imports is spectacular in Arab countries (79.85%) and South Asia (45.44%). However, tariff reforms produce only a very small growth of imports in the OECD (0.86%) and even reduce them in East Asia and Pacific (-4.49%).

Columns 2 and 3 quantify the growth of imports caused by the reduction in the average tariff and the change in variance. Average tariff reductions are responsible for important increases in imports, 19.07% for the total sample and particularly true for

Table 2. Robustness analysis.

Growth of imports	(1)	(2)	(3)	(4)	(5)	(6)	(7)
b	0.0026*	0.0024**	0.0039***	0.0039***			
	(0.080)	(0.058)	(0.001)	(0.000)			
Growth of Tariff Revenue (GTREV)	0.1282***	0.2403***	0.1128***	0.1138	0.1406***	0.1400***	0.1446***
	(0.003)	(0.002)	(0.000)	(0.000)	(0.002)	(0.002)	(0.026)
Growth of Per Capita GDP (GPCGDP)		0.3115***			0.2689***	0.2723***	0.3037***
		(0.000)			(0.000)	(0.000)	(0.000)
Lag Growth of Per Capita GDP (lagGPCGDP)	0.2407*						
	(0.06)						
Lag Growth of Population (lagGPOP)	0.3485						
	(0.532)						
KOR-US		–14.8735***			–15.6681***	–15.6759***	–12.3574***
		(0.000)			(0.000)	(0.000)	(0.000)
China-ASEAN		–10.50714					
		(0.174)					
APEC		–0.8649					
		(0.506)					
ASEAN		–7.7142***					
		(0.029)					
Growth of Balassa's Trade Orientation (GTO)					–0.0114***	–0.0115***	–0.0119***
					(0.045)	(0.040)	(0.038)
Variation in Real Effective Exchange Rate (GREER)			0.4374***				
			(0.021)				
b-Latin America & Caribbean					0.0025***		0.0027***
					(0.000)		(0.016)
b-South Asia							0.0015
							(0.357)
b- East Asia and Pacific						0.0392***	0.0427*
						(0.028)	(0.097)
b-Sub-Saharian Africa							–0.0261
							(0.186)
b-Arab Countries							0.0256
							(0.173)

b-Europe and Central Asia							–0.1168
							(0.144)
b-OECD							–0.0025
							(0.331)
b-Developed non-OECD							0.0069
							(0.118)
b-other than Latin American & Caribbean					0.0025		
					(0.120)		
b-other than East Asia & Pacific						0.0025***	
σ						(0.028)	4.4333***
							(0.000)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Baier-Bergstrand (GMR)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Changes in NTBs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WB-year		Yes	Yes	Yes	Yes	Yes	Yes
Adj R^2(%)	27.33	48.14	34.24	30.95	47.76	47.87	49.82
Obs	218	293	192	192	327	327	327

Note: $b = 1/2(1 - M_b)$ where M_b is the marginal propensity to spend on imports. It is assumed the theoretical value of $\varphi = 1$.
***,** and * indicate significance at 99, 95, and 90% confidence levels respectively. Robust p-values are in brackets.

Table 3. Cumulative effect of tariff reforms on market access (2000–2009).

	Growth of imports for tariff reforms (%)			Change in the Uniform Tariff (%)	
	Total	ΔT	ΔV	gMTRI	gMTRI/ ΔT
All countries	18.84	19.07	–0.23	–4.77	98.81
Latin America and Caribbean	19.54	18.82	0.73	–4.88	103.86
South Asia	45.44	45.44	0.00	–11.36	100.00
East Asia and Pacific	–4.49	1.84	–6.33	1.12	–244.12
Sub-Saharan Africa	12.81	12.81	0.00	–3.20	100.00
Arab countries	79.85	79.85	0.00	–19.96	100.00
Europe and Central Asia	19.66	19.66	0.00	–4.91	100.00
OECD	0.86	0.86	0.00	–0.21	100.00
Developed non-OECD	7.82	7.82	0.00	–1.96	100.00

Note: Accumulated effects in South Asia until 2008. In Europe and Central Asia and Developed non-OECD from 2002.

South Asia and Arab countries. The contribution of variations in the tariff structures to increasing market access reveals an interesting picture. For the total sample, the change in tariff structure has contributed negatively to market access, indicating a selection of products whose liberalization does not result in more trade. On the contrary, with a neutral selection, they would have grown 0.23% more. This means that the aggregate liberalization is smaller than the one indicated by the reduction in the weighted average tariff. This is particularly important in East Asia and Pacific, which accumulates a 1.84% growth of imports due to the reduction in the w.a.t.. However, there is a restrictive selection that yields a 6.33% reduction in imports with a total effect of a 4.49% reduction. The opposite is found in Latin America and Caribbean, where the reduction in the w.a.t. produces a 18.82% cumulative growth of imports, much larger than that of East Asia and Pacific, and the product selection in tariff reforms expands aggregate imports by an additional 0.73%. These results contrast with the traditional performances of these regions, less open to trade in Latin America and Caribbean and highly open in East Asia and Pacific. The rest of the regions show a neutral role of the change in tariff structures and the increase in market access responds to reductions in the w.a.t.

Column 4 shows the change in the MTRI from 2000 to 2009, which consistently measures the change in market access in each region. The comparison of the growth of MTRI with the variation of the w.a.t. is shown in column 5. For the total sample, the value of gMTRI shows that tariff reforms are equivalent to reducing the uniform tariff by 4.77%, smaller than the reduction in the w.a.t. due to a restrictive selection. An index lower than 100% in column 5 indicates the size of this restrictive selection, equivalent to a 0.06% increase in the uniform tariff that counteracts the effect of the reduction in the w.a.t. by 1.19%. If it is higher than 100%, it reveals an expansive selection, as in Latin America and Caribbean which, with tariffs levels that are, on average, lower than in some of the regions mentioned, reduce the restrictiveness of tariffs both on average and through a selection of the liberalized products. Latin America and Caribbean shows a 4.88% cumulative reduction in gMTRI, where the impact of dispersion is equivalent to a 0.18% reduction in the uniform tariff. However, it is remarkable the size of the restrictive selection in East Asia and Pacific where, although the w.a.t. decreased by 0.46%, the gMTRI increases 1.12% because of the

1.58% increase of the dispersion effect. This result is evidence that, in East Asia and Pacific, tariff reforms focused on the reduction in dispersion with an important sacrifice in market access.

7. China's restrictive reforms and scenarios of tariff liberalization

China leads trade dynamism in the Asian region and in the world, so Chinese trade policy has a global effect and deserves attention. Among the extensive literature about China's shift toward integration into the world economy, Lee and Park (2005) evaluate proposed East Asian FTAs, such as ASEAN+3. They find that the trade creation in these initiatives is significant enough to overcome the trade diversion. Lee and Shin (2006) analyze trade integration in East Asia and the clear shift away from globalism toward regionalism since early 1999. Intra-Asian trade is primarily attributed to the rise of bilateral trade between Asian countries and China. The role of China is decisive in the global integration of trade in East Asia, and still has much potential given China's commitment with the multilateral liberalization of trade since its accession to the WTO.

During our period of study, China has multiplied its imports by a factor of 4.6. Its w.a.t. has decreased from 13.59% in 2000 to 3.56% in 2009, and the weighted variance of the Chinese tariff structure has been reduced by 8 times from 2000 to 2009. These variations are in line with the WTO recommendations of reducing the average tariffs and with that of the World Bank of reducing the dispersion in the tariff structure. However, while a reduction in the variance results in an increase in welfare, it also reduces market access.

Our analysis allows us to simulate different proposals of tariff reform and assess their impact on the volume of imports and on market access. We consider two scenarios of tariff reform in China and compare the effects on market access with the estimated effects. UNESCAP (2009) analyzes the impact of trade policy on Asia-Pacific development. The report explores several scenarios in 2004 of Asia-Pacific integration ranging from a small 25% reduction in tariffs to total liberalization under WTO membership, obtaining important effects on poverty reduction. We simulate similar scenarios here: a small proportional 25% tariff reduction and total liberalization. We compare these results with those estimated in this paper and with those from a neutral selection of tariff reductions that maintains the actual reduction in the w.a.t. and an unchanged import-weighted tariff variance.

Table 4 presents the results of the individual estimation of parameter b for China based on Table 1 column 6. In column 1, we estimate a separated coefficient for China. In column 2, we introduce the effect of the RTAs ASEAN and KOR-US. In column 3, we estimate a common b for the whole sample and a differentiated impact for China. The b parameter is 0.057 for China and 0.0024 for the rest of the sample. These estimations show a notably larger, almost double, impact of changes in tariff dispersion on China's imports than the average in East Asia and Pacific.

We use the estimates in column 2 to calculate the effects of China's tariff reforms on imports and to estimate the gMTRI. The first line in Table 5 presents the effect accumulated in this period. Reduction in the w.a.t. generates a 40.09% growth of imports, but the cumulative reduction in dispersion dominates and reverses that effect, resulting in a total 5.89% contraction of imports. This is equivalent to imposing a 1.47% uniform tariff on imports instead of dismantling the tariff barriers. If China had implemented a neutral reform with unchanged dispersion, the result would have been

Table 4. Country estimation: China.

Growth of imports	(1)	(2)	(3)
b-China	0.0571***	0.0568***	0.0544**
	(0.050)	(0.028)	(0.055)
b-no China	0.0025***	0.0024***	
	(0.028)	(0.021)	
b			0.0024***
			(0.021)
Growth of Tariff Revenue (GTREV)	0.1404***	0.1436***	0.1436***
	(0.002)	(0.002)	(0.002)
Growth of Balassa's Trade Orientation (GTO)	–0.0116***	–0.0114***	–0.0114***
	(0.037)	(0.035)	(0.035)
Growth of Per Capita GDP (GPCGDP)	0.2714***	0.2778**	0.2777***
	(0.000)	(0.068)	(0.000)
KOR-US	–15.6785***	–15.6025***	–15.6025***
	(0.000)	(0.000)	(0.000)
ASEAN		–9.0254***	–9.0254***
		(0.007)	(0.007)
year dummies	Yes	Yes	Yes
Baier-Bergstrand (GMR)	Yes	Yes	Yes
Importer fixed effects	Yes	Yes	Yes
Changes in NTBs	Yes	Yes	Yes
WB-year	Yes	Yes	Yes
Adj R^2(%)	47.85	48.98	48.98
Obs	327	327	327

Note: Robust *p*-values are in brackets.
***, ** and * indicate significance at 99, 95, and 90% confidence levels respectively.

Table 5. Effect of tariff reforms on market access in China (2001–2009).

	Growth of imports for tariff reforms (%)			Change in the Uniform Tariff (%)	
	Total	ΔT	ΔV	gMTRI	gMTRI/ ΔT
Cumulative 2000–2009	–5.89	40.09	–45.98	1.47	–14.68
Cumulative 2004–2009	–0.19	9.77	–9.96	0.05	–1.94
Baseline 2000:					
25% proportional cut in tariffs	–12.72	13.59	–26.31	3.18	–93.63
Total liberalization	1.73	54.34	–52.61	–0.43	3.18
Baseline 2004:					
25% proportional cut in tariffs	–2.18	6.00	–8.19	0.55	–36.34
Total liberalization	7.65	24.02	–16.37	–1.91	31.83

a 40% increase in imports. In the second line, we calculate the same effects from 2004, previous to China's agreement with the ASEAN, finding a strong restrictive selection that completely counteracts the reduction in the w.a.t.

In lines 3 and 4, we simulate a 25% proportional cut and total liberalization, with 2000 as their baseline. A 25% proportional cut is much more restrictive than the reforms actually carried out in China. The reduction in dispersion contracts imports by 26.31% reversing the effect the reduction in the w.a.t., equivalent to imposing a 3.18% uniform tariff. Total liberalization would yield a 1.73% increase of imports because the 54.34% generated by the reduction in the w.a.t. is almost counteracted by the elimination of dispersion. Using 2004 as their baseline yields similar evidence.

To sum up, tariff reforms in China from 2000 to 2009 had an important cost in terms of market access because of the reduction in tariff dispersion. Total liberalization would increase market access but a reform neutral with the tariff structure would improve largely market access and also welfare.

8. Conclusions

In this paper, we analyze the effect of changes in tariff dispersion through tariff reforms on market access. We use an aggregate gravity model to estimate the relevant parameters to calculate Anderson and Neary's growth of the MTRI. Depending on the effect of changes in tariff dispersion on the growth of imports, we define the effects of changes in tariff dispersion as restrictive, expansive or neutral. The corresponding growth in the equivalent uniform tariff is higher, lower or the same as that of the w.a.t. This is a novel estimation methodology and we show its possibilities to estimate the effects of tariff reforms for individual countries using a data panel. We obtain results robust to the inclusion of controls for changes in NTBs, openness, tariff incomes, factor endowments and/or level of development, participation in the main RTAs, other regional and time effects as well as endogeneity, trade orientation, real effective exchange rate, and to the estimation of the elasticity of substitution, which is in the range of values used in the literature.

We confirm notable regional differences in the effect of changes in tariff dispersion on market access. In Latin America and Caribbean, the effect of changes in tariff dispersion is similar to that of the total sample. In East Asia and Pacific, we find a strong effect, 16 times the average. For the rest of the regions there is no effect.

We calculate the effects of tariff reforms from 2000 to 2009 on market access by country-year. In total average, tariff reforms accumulate an 18.84% growth of imports during the period. There is a restrictive effect of the changes in dispersion that is equivalent to imposing a 0.06 uniform tariff. By region, in Latin America and Caribbean, the role of dispersion is expansive and, together with the reduction in the w.a.t., accumulate a 4.88% reduction in the MTRI. However, we find a strong restrictive role of dispersion in East Asia and Pacific, where reductions in the w.a.t. are reversed by the effect of dispersion, causing a 4.49% contraction in imports which is equivalent to a 1.12% rise in the MTRI.

In the paradigmatic case of China, the effect of changes in dispersion almost doubles the effect in East Asia and Pacific. China generates an important growth of imports due to the reduction in the w.a.t., but the strong restrictive effect of reducing dispersion reverses that effect. Tariff reforms have important costs in terms of market access and are equivalent to a 1.47% increase in the MTRI. We simulate alternative tariff reforms in China. The reduction in the w.a.t. actually carried out in China, combined with a neutral effect of unchanged dispersion, would have generated a 40.09% growth of imports, the best alternative which improves both market access and welfare.

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Note

1. Estimating the MTRI with gravity equations offers a compensated MTRI with imports at domestic prices. However, we estimate the growth rate of imports, eliminating this problem, and control variation in world prices with time dummies.

ORCID

Carmen Fillat-Castejón http://orcid.org/0000-0002-9076-3743

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